Gunsmithing Tools Lab

SONORAN DESERT INSTITUTE

SCHOOL OF FIREARMS TECHNOLOGY

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Content written by Frank Vigil

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Introduction

Firearms, like any industry, require knowledge, experience and the right tools to properly service, repair, disassemble and completely reassemble, assuring everything is in optimal condition when complete. Much of the knowledge and experience come from reading articles or blogs, watching videos, and actual "hands-on" practice. Because there is a huge array of different firearms, actions, and models, it would almost be impossible to fully understand every nuance or procedure. Basic knowledge of the methodologies involved in the disassembly and assembly and the tools needed to complete these tasks will prepare you to work on any platform, regardless of experience. To teach these methodologies, this course will cover the topics

of safety, preparation, planning, field stripping, detail stripping, and assembly. We have purposefully blended these techniques, along with the knowledge of tools used by gunsmiths, to provide a complete view of firearms repair.

Safety and Preparation

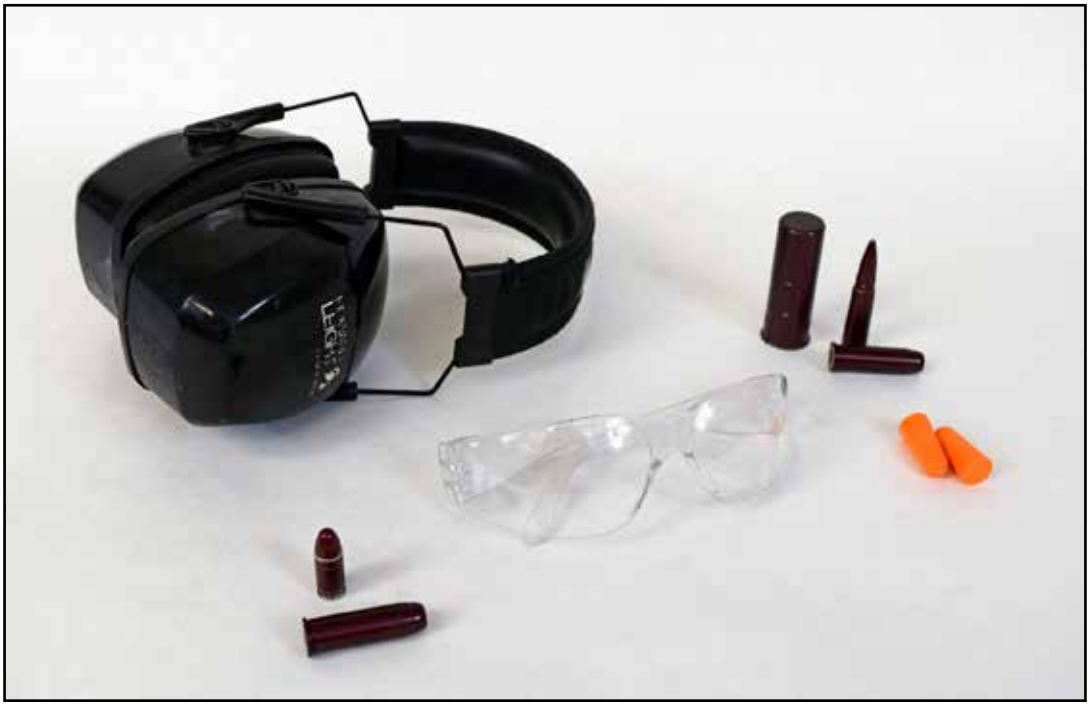
Working with firearms is not as dangerous as some would assume, but there are inherent dangers that can be nullified with a few basic safety rules. These rules will ensure your safety and the safety of everyone around you at all times. The rules are:

- **Treat every firearm as if it were loaded.**
- **Never point a firearm at anything you do not intend to destroy.**
- **Know how to safely operate your firearm and how all of its safeties work.**
- **Use appropriate eye and ear protection.**
- **Always keep firearms unloaded until ready to use.**
- **Live ammunition is not allowed in the work area.**
- **Never use live ammunition to function check firearms; use snap caps only.**

Preparation for disassembly is threefold: preparation of the firearm, preparation of your workspace and tools, and mental preparation. Preparation of the firearm is the same, regardless of type or model. Preparation of your workspace and tools comes from experience. Mental preparation is different for everyone, but is probably more important than the preparation of your tools and workspace.

Before ever touching a firearm or tool, you need to prepare yourself mentally. You must put yourself in the correct mindset so that your focus is on safety first. Even though you will not be on a range or shooting, you will still be handling a firearm and possibly ammunition. You will be working with small parts, loaded springs, and you will be exposed to lead and other chemicals. Your mental preparation should be tailored so that you can remove yourself from outside distractions and place all your focus on the task at hand.

Once you feel like you are mentally prepared, you can begin to prepare the firearm. The first step in preparing any firearm for work is to clear it. Clearing a firearm involves removing its feed source and ammunition and making



sure the chamber is clear. Clearing a firearm is always done in the same sequence; failing to complete the sequence in order can lead to a very dangerous situation. The steps to clearing any firearm are:

1. Set the firearm's selector/safety to the Safe position. Some designs will not allow you to set the safety as it will interfere with clearing the action (i.e. 1911).

2. With repeating and semi-automatic firearms, remove the feed source. This means any box, drum, or detachable tubular magazine. For revolvers, unlock the cylinder or open the loading gate. For firearms that utilize a fixed internal or tubular magazine, unlock and open the action.

3. Unlock and open the action to manually extract and eject any cartridges left in the chamber. If the firearm utilizes a fixed magazine, you may have to manually cycle the action several times before all the cartridges are removed from the action. Once the action is clear, manually cycle the action several more times to verify. For revolvers, use the ejector rod to empty the chambers in the cylinder.

4. Lock the action open (if possible) and physically and visually check the chamber. Use your finger to feel inside the chamber and look to verify it is clear. If the firearm utilizes a fixed magazine, verify the magazine is empty and you can see and feel the magazine's follower.

Figure 1a: Clearing a firearm Step 1- Setting the safety.

Figure 1b: Clearing a firearm Step 2- Removing the feed source.

Figure 1c: Clearing a firearm Step 3- Extracting and ejecting.

Figure 1d: Clearing a firearm Step 4- Action locked open.

The firearm is now clear and safe to handle. Remove any live ammunition from the workspace and the room to prevent any accidental loading. If there is ammunition left in any feeding devices, remove it as well. If you need to function test the firearm at any point, use snap caps or "dummy rounds" to assure you are doing it in the safest way possible.

Later we will discuss the preparation of your workspace. Before setting up your workspace, make sure you have a solid grasp of the tools and procedures necessary to properly and safely disassemble and reassemble the firearm. Proper research and planning will assist you in the set-up of your tools and workspace.

Basic Hand Tools

Most firearms only require a minimal amount of hand tools to completely disassemble and reassemble. Knowing which tools are appropriate and correct for each part of the job and how to properly use each tool will prevent unintentional damage to the firearm or its parts. Over time, your tool collection will grow with your experience and skill with these tools. Having the right tool for the job will often be the difference between success and failure.

HAMMERS AND MALLETS

Hammers are one of the oldest tools and are one of the most utilized tools in the workshop. Hammers are available in many shapes and sizes, in several different types of materials, for a variety of purposes. Hammers can be used as a standalone tool, or to drive other tools. The difference between a hammer and a mallet is the material. Hammers are composed of metal and are typically used on metal, while mallets are made of plastic or wood and are used on non-metals.

There are a few types of hammers that are used when working with firearms. They range in type, weight, material, and purpose. The basic types of gunsmithing hammers are:

- **Ball-peen** – The ball-peen or "machinist's hammer" is a type of hammer that utilizes two integral faces on its head. One face of the head is flat while the other is a hemisphere. The flat face is used to drive other tools, such as punches and chisels. The half-round face is used when more precision is needed or the work area is smaller. The half-round face is also used for a technique known as peening. Peening involves striking the surface of a metal part to create a small dimple and harden the area. The peening process has been somewhat replaced with "shot" peening.

Figure 2: Basic hand tools.

- The ball-peen hammer is found primarily manufactured from some alloy of hardened steel. The head is securely fixed to a wood (often hickory) or composite handle. Weight can range from 1 oz. to 1 lb., with the most popular sizes being 2 oz., 4 oz., 8 oz., and 16 oz. You may find it useful to own several different sizes of hammer for various types of processes. There are variants of the ball-peen known as straight-peen and cross-peen hammers, which feature chisel-type faces opposite of the flat face. These types of hammers are not typically seen in a gunsmithing shop. The ball-peen is typically the workhorse of all the different hammers, capable of handling any project, large or small.

- **Brass** – The brass hammer is a type of hammer that utilizes a solid brass head. The head may have two faces like the ball-peen but is constructed from solid brass. The brass hammer is used in the same way as the ball-peen, but for smaller projects. Because the brass hammer is often lighter and softer than a steel ball-peen, it will not deliver as much energy. Also, it will not scratch the surface of the workpiece like a steel hammer will. The brass head is attached to a wood (often hickory) or composite handle. The brass hammer can be found in sizes from 1 oz. to 1 lb., with the most popular sizes being 4 oz. and 8 oz. The brass hammer is usually reserved for smaller jobs, driving smaller pins that require less force.

Figure 3: Two types of ball-peen hammers.

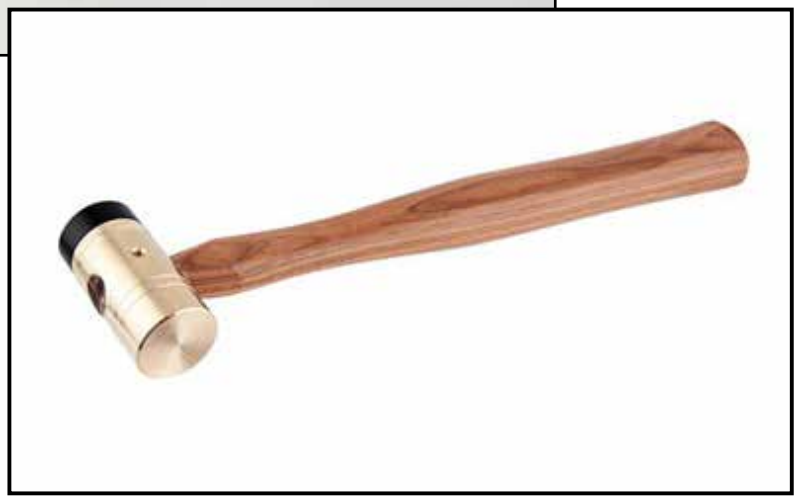


Figure 4: Brass hammer.

Figure 5: Several hybrid or tipped hammers.

Figure 6: A rawhide mallet.

- **Hybrid/Tipped** – The hybrid or tipped hammer is a type of hammer that utilizes multiple or replaceable heads of various materials. The head will have two faces, one of which may be metal and the other Delrin®, polymer, or rubber. Using faces with dissimilar materials makes the hammer more suitable for multiple projects. Typically, the head is made of brass or steel, with single or multiple faces that are either pinned or screwed into the head. The softer polymer and rubber faces allow you to apply force to the workpiece without fear of deforming or marring the workpiece. The metal head is securely attached to a wood or composite handle. Hybrid or tipped hammers can be found in sizes from 1 oz. to 8 oz., with the most popular size being around 6 oz. The hybrid or tipped hammer is capable of various sized projects.
- **Rawhide Mallets** – The rawhide mallet is a type of mallet that features a head made of roller leather and epoxy. The softer head material is best suited for applying force to wood and metal parts where finish is concerned. The leather head is securely attached to a wood or composite handle and can range from 6 oz. to 16 oz.

PUNCHES

Punches are used to drive various types of pins that are found on firearms. Punches are typically made of metal and feature a rod-shaped body. The head of the punch will differ depending on its type. Depending on the pin, a hammer may be used to drive the punch into the pin. There are several different types of punches for the various pins you will encounter. The various types of punches are:

- **Starter –** A starter punch, as its name implies, is a type of punch that is used to "start" moving or drifting a pin that is already set in a hole. A starter punch, like many other punches, features a body that is a larger diameter than the tip and shank. The shank tapers from the tip to the body and the whole punch is very stout. Starter punches come in various sizes for both solid and roll pins. When used, the starter punch will only drive the pin a short distance before the punch bottoms out against the mouth of the pin hole. The tapered shank provides the punch with enough strength to resist bending and flexing when driving frozen, stubborn, or pressed pins. Starter punches can be found in both brass and hardened steel.

Figure 7: A selection of starter punches.

- **Pin** – A pin punch is a type of punch that is used to drive pins completely through the workpiece. A pin punch features a body that is a larger diameter than the tip and shank. The tip and shank of the pin punch are the same diameter and the shank is straight from the tip to just ahead of the body. There is either a slight taper from the shank to the body or a sharp shoulder. When used correctly, the shank of the pin punch should match the diameter of the pin or be slightly smaller. The shank of the pin punch will move through the pinhole of the workpiece and drive the pin completely out. The pin punch can also be used to drive pins back into the workpiece. Pin punches should only be used with solid pins because they can damage roll pins. Pin punches can be found in various materials including steel, brass, aluminum, and nylon. Brass, aluminum, and nylon punches can be used to drive components other than pins, like dovetail sights.
- **Roll Pin** – Roll pin punches, as their name implies, are punches that are used to drive roll pins. The difference between a pin punch and a roll pin punch is the design of the tip. While a pin punch features a flat face on its tip, the roll pin punch features a small domed protrusion in the center of its tip. This small, domed point is meant to prevent the roll pin from deforming by supporting the open center of the pin. The roll pin punch is used in the same way as the pin punch, but specifically for roll pins. Roll pin punches are found primarily made of steel.

Figure 8: A selection of pin punches.

Figure 9: A selection of roll pin punches.

- **Center** – A center punch is a type of punch that is used to make an indentation in the workpiece in preparation for drilling. The difference between the center punch and other types of punches is in the way it is used. The tip of the punch comes to a sharp point, while the shank tapers into the body. The shape point of the center punch will create a precise indentation in the workpiece when struck with a hammer. The indentation is meant to prevent the tip of the drill bit from "walking" or drifting when contacting materials like metal. The indentation will guide the tip of the bit so that the hole is drilled in the precise location. The center punch is made of steel with a hardened tip.
- **Drift** – The drift punch or drift pin is a type of punch that is used to align pinholes. Like the center punch, the drift punch is not used in the same way as other punches. The tip of the drift punch

Figure 10: A selection of center punches.

Figure 11: A selection of drift punches.

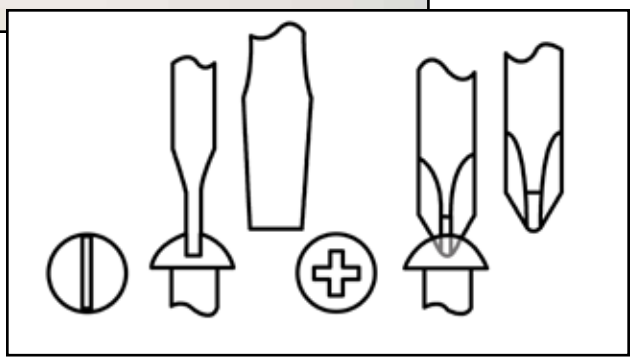


Figure 12 (top): Various flat head and Phillips-head screwdrivers.

Figure 13: Fitment of the screwdriver to the screw.

is flat and features a long shank that tapers into the body. The long, tapered shank is used to align the pinholes of two different parts so they can be pinned or screwed together. The two parts must be partially aligned before the drift punch is inserted and tapped until the holes are perfectly aligned. The drift punch is typically made of steel but can also be found in brass.

SCREWDRIVERS

Screwdrivers are used to remove and install screws that are used in firearms. The basic screwdriver design features a handle, shank, and tip. There are two basic types of screwdriver designs based on the tip. The two basic types of screwdrivers are flat head and Phillips-head. The flat head screwdriver features a tip that is flat or blade-shaped. The flat head screwdriver is designed to work with slotted screws. The Phillips-head or cross recess screwdriver features a tip that is cross-shaped and that tapers to a point. The Phillips-head screwdriver is designed to work with Phillips-head screws.

Regardless of the screw type, when correctly used, the tip of the screwdriver should fit precisely in the screw head. With slotted screws, the tip of the flat head screwdriver should fit the slot in both length and width. The tip should also match the taper in the slot, if present. The same applies to the Phillips-head screwdrivers and screws as well. Any slop in the fitment of the screwdriver to the screw can result in damage to the screw head. Using the correct tip will ensure that you can properly remove or install a screw without damaging the screw, workpiece, or finish.

Figure 14: Screwdriver bit sets.

While the basic screwdriver design (handle, shank, and tip) is available in many different sizes, there are screwdriver bit sets available that offer a far greater range of types and sizes. A bit set consists of a single handle with a shaft that features a hollow tip. Various types and sizes of bits will lock into the shaft via magnet or detent. Collecting various bit sets will ensure you always have the proper size for the screw at hand. Some handles may also include a ratcheting feature that enhances its usability.

WRENCHES

Wrenches are used to remove and install nuts and bolts that may be found on firearms. There are many different types of wrenches to work with the various types of nuts and bolts that you may find. The various types of wrenches include:

- **Open-Ended/Box Wrench** – Open-ended and box wrenches are used to remove and install hexagon or "hex" head bolts and hex nuts. These types of wrenches are typically double-sided, meaning there is a wrench head of different size on each end of the wrench. The difference between open-ended and box wrenches lies in their name: open-ended wrenches feature a set of open jaws shaped like one side of a hexagon; box wrenches feature a head that is loop-shaped with "teeth" along its inner diameter. There are also combination wrenches with a box head on one side and an open one on the other. Wrenches come in an array of sizes and are made of steel.

Figure 15: Various open-ended and box wrenches.

Figure 16: Various adjustable wrenches.

- **Adjustable Wrench** – An adjustable wrench, as its name implies, is a type of wrench with an adjustable head. Shaped similar to an open-ended wrench, the adjustable wrench features a bottom jam that moves via an adjustment screw located on the head of the wrench. Turning the screw will move the jaw up and down and adjust the wrench to the size of the bolt at hand. The adjustable wrench offers the user a greater range of usability, but is also more likely to strip a bolt head than a tradition wrench of the correct size. Adjustable wrenches can be found in various sizes and are made of steel.
- **Socket Wrench** – A socket wrench is a type of ratcheting wrench that uses sockets of varying sizes to remove and install nuts and bolts. The socket wrench utilizes an array of gears, springs, and locks to create the ratcheting motion. There is a switch on the head of the wrench that allows the gears to reverse their motion so that the wrench can be used to remove and install nuts and bolts. On the head of the wrench is a square "drive" used to attach the various sockets. Wrenches come in various sizes with standardized square drivers in ¼ in.,⅜ in.,and ½ in. The drivers typically feature a spring-loaded detent meant to hold the socket to the head.

  Sockets are typically tube-shaped. One end features a hollow pocket designed for the drive and the other end features a pocket that is shaped for hexagonal bolt heads and nuts. Sockets come in a huge array of sizes in both standard and metric

Figure 17: Various socket wrenches and sockets.

Figure 18: A torque wrench.

and can be often found in sets of 30 pieces or more. Socket wrenches speed the process of removing and installing many different nuts and bolts without the need for lots of different wrenches.

- **Torque Wrench** – A torque wrench is a type of specialty wrench used to measure the amount of force applied to the nut or bolt. The torque wrench looks similar to a socket wrench but with an added feature that displays the torque being applied. The display can either be analog (like with a beam torque wrench) or digital (like with an electronic torque wrench) and some may not even feature a display (like a micrometer torque wrench). The micrometer torque wrench utilizes an adjustable collar used to adjust the amount of torque that can be applied. When the desired torque is reached, the wrench will make an audible click as it disengages from applying torque. There are two basic types of torque wrenches in various sizes used to measure torque in both inch-pounds (in-lb.) and foot-pounds (ft-lb.). Torque wrenches are precision instruments and are typically used for the final torque adjustments after a standard wrench has completed most of the work. Torque wrenches should not be used to remove nuts and bolts.

- **Allen/Torx Wrenches/Keys** – The Allen/Torx wrench or "key" is a type of wrench used to drive bolts or screws (both machine and wood) with a specialized socket in their head. The difference between the Allen and Torx wrench is the shape of the tip. The Allen wrench features a hexagonal tip that extends through the whole body, while the Torx utilizes a six-sided star head that tapers into a round body. Both the Allen and Torx wrench feature a 90° bend near the head to provide more leverage when removing and installing bolts and screws. Ball-end Allen wrenches feature a ball-shaped tip that allows the shank of the wrench to be held at an angle (to the center axis of the bolt) in hard-to-reach areas. Allen and Torx wrenches can be found in an array of sizes in both standard and metric and are always made of steel.

Figure 19: Various Allen and Torx wrenches.

Figure 20: A strap wrench.

Figure 21: Combination pliers.

- **Strap Wrench** – A strap wrench is a type of wrench used to apply torque upon parts other than bolts, such as handguards or receivers. The strap wrench is very different than the standard wrench, featuring a handle and a long reinforced rubber strip that loops through the handle. One end of the loop is fixed to the handle, while the other end moves freely. The free end loops through the handle and is held in place by a lever. When the lever is manipulated, the strap can be adjusted to fit the size of the workpiece. When used correctly, the strap is placed over the workpiece and tightened. Once the strap is taught you can begin to apply torque to the workpiece. The handle of the strap wrench is typically metal or plastic and the strap is usually made from fiber-reinforced rubber. Strap wrenches come in various sizes for different tasks.

PLIERS

Pliers are hand tools that are used to hold or grab a workpiece. The general design of pliers utilizes a set of mirrored levers that are pinned near the head to create a pivot point. The area ahead of the fulcrum forms the jaws while the area behind the pivot point forms the handles. The length of the handles creates a mechanical advantage and allows the user to apply a magnified force on the workpiece. There are several different types of pliers for various tasks. The most common types of pliers used in gunsmithing are:

- **Combination** – Combination pliers are the basic type of pliers. Combination pliers utilize serrated jaws with both a flat section and a round section used to grab both flat and round workpieces. The serrated jaws increase the pliers' grip and prevent them from slipping off of the

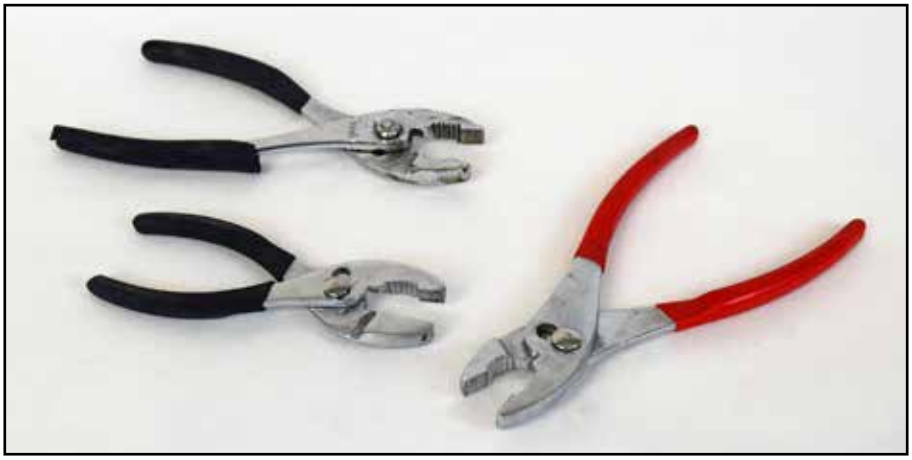


Figure 22: Various slip joint pliers.

Figure 23: Various needle-nose pliers.

workpiece. Although pliers are not designed to work as a wrench, they can be used in a pinch, but they are almost guaranteed to strip or round the bolt head. Combination pliers can also be found with flat and padded jaws to prevent any marring of the workpiece. Combination pliers can be found in various sizes and are made of steel.

- **Slip Joint** – Slip joint pliers are an adjustable version of combination pliers. One of the levers features an elongated slot on its fulcrum so the lever can change its position and adjust the width of the pliers' jaws. Adjustable jaws allow the slip joint pliers to work with an additional number of different sizes of workpieces than traditional combination pliers. One downside of the design is the fact that the handles are spaced farther apart when the jaws are widened, making one-hand manipulation difficult. Slip joint pliers are found in a variety of different sizes for various tasks.
- **Needle-Nose** – Needle-nose pliers are a type of pliers that utilize long, pointy jaws. The small profile of the jaw's tip is meant to grab small workpieces or to work in hard-to-reach areas. The jaws typically feature very fine serrations but may also be smooth and rounded. Needle-nose pliers can be found in various sizes for many different tasks.
- **Channellock®** – Channellock or tongue-and-groove pliers are an adjustable type of pliers that can produce more toque than slip joint pliers. Channellock pliers differ from traditional adjustable pliers in several ways. Unlike slip joint pliers, whose jaws and handle run parallel, the Channellock utilizes jaws that are set at an angle (typically 45º) to the handle. This allows the width of the jaws to increase without increasing the

Figure 24: Channellock pliers.

Figure 25: Various vise grip pliers.

size of the handles. The second difference is the amount of adjustment and method. While slip joint pliers may only have one or two points of adjustment, Channellocks will feature many more. One lever of the pliers features a protrusion (tongue) that corresponds to several grooves on the other handle. When the jaws are opened, they move along a slip joint until they are adjusted to the correct size. When the handles are closed, the tongue slips into the groove and creates a torque lug to strengthen the jaws so more pressure can be applied. Channellock pliers can be found in various sizes for a variety of tasks.

- **Vise Grip** – Vise grip pliers are a type of locking pliers that maintain their hold after you have let go of the handles. Vise grips utilize a single lever with a fixed jaw that is linked to a pivoting jaw and handle. There is an adjustment screw that, when manipulated, adjusts the size of the jaws so they can be used on various sized workpieces. After the jaw size has been adjusted, when the handles are closed, the jaws will lock in place. To release the pliers, a release lever on one of the handles unlocks the jaws and allows the handles to open. Vise grips can be found in a variety of sizes and shapes for many different tasks.

OTHER HAND TOOLS

Besides the basic hand tools that are general to most professions, there are other hand tools that can help with many different gunsmithing projects. Looking toward other industries for tools may make certain projects easier and may reveal better options. These tools include but are not limited to:

Figure 26: Two types of tweezers.

Figure 27: Various types of picks.

- **Tweezers** – Tweezers are a medical or cosmetic tool used for grabbing and pulling small items from tight spaces. Tweezers consist of two-spring, steel fingers that are fixed together at one end. The opposite ends are shaped to a sharp or rounded point and the jaws are typically ground flat. The fingers are pinched to bring the jaws together and released to spring back open. Tweezers are used to grab or hold small parts such as springs or pins. Tweezers can be found in various sizes with different tips for many tasks.

Figure 28: Hemostat.

- **Picks –** Picks are a type of tool used to poke, prod, and scrape in hard-to-reach areas. A pick consists of a handle and a long, smaller diameter tip that comes to a sharp point. Various picks will have tips that are bent in different ways to fit in different tight spaces. Picks will typically come in sets with straight, bent, and curved tips as well as double-sided picks with tips on each end. Dental picks can also be used.
- **Hemostat** – A hemostat is a medical instrument used to close veins and arteries during surgery. A hemostat is similar to a pair of locking pliers with a needle nose. Hemostats utilize a pair of ratcheting locks on the handles to keep the jaws closed. Hemostats are used in the same way as tweezers, but are capable of being locked. The jaws of the hemostat are lined with fine serrations. Hemostats can

Figure 29: Firearm markings.

be found in various sizes with straight or curved jaws for different purposes.

RESEARCH AND PLANNING

At this point, the firearm has already been cleared and made safe and is ready for disassembly. If you are not completely familiar with the firearm or its disassembly procedure, now is the time to research and plan the disassembly/reassembly. The internet is an awesome source for information and specific disassembly procedures for almost any firearm. There are many articles, tutorials, and videos, as well as parts diagrams and drawings. Other sources of information include the factory manual and possibly the factory itself. Research will reveal specific nuances of the disassembly and reassembly processes that may have not been apparent before and will also give you a rough idea of a timeline.

Note specific markings on the firearm itself. Manufacturers will often change a few areas of a specific model and reintroduce it as a different model number. Most of the parts between the two models will be interchangeable, while some will not. Researching serial numbers may also reveal some hidden knowledge of that specific model that will assist you during the disassembly and assembly processes.

Research will also help you prepare your tools and workspace. You want all the tools that are necessary for the build to be near you and organized. Your workspace should be large enough to lay out your tools and all the parts you are disassembling. The workbench or table should be able to withstand the force of hammering and torqueing that some parts/assemblies may require to remove. Additionally, your workspace will need to be well lit.

The organization and cleanliness of the workspace is also very important. You must realize when disassembling firearms, it is not a matter of "if" but "when" you will lose a small pin or spring. If your workplace is messy and dirty, the chances of finding your part are lessened. You may want to use trays or bins to hold small parts while you are working. You may also want to cover the workbench with a piece of soft carpet or a towel to prevent scratching the finish on the firearm.

Taking the time to prepare yourself mentally and prepare the firearm, your tools, and the workspace will save you time and frustration during the disassembly and assembly process. It will also help to move the process along smoothly and quickly. Over time, the preparation process will become second nature and you will begin to see areas of your prep that can be improved or changed and allow you to perform the processes more efficiently.

Figure 30: A well-organized workspace.

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Cutting Tools and Abrasives

Working with firearms is more than just general maintenance, cleaning and disassembly, and assembly. At some point, you may have to fit certain parts or refinish them. This is where you would need certain cutting tools to complete your tasks. Cutting tools will vary based on purpose and the material of the workpiece. The most common cutting tools are:

- **File** – A file is a tool used to remove material from a workpiece through a series of tiny cuts or scratches. The basic file is a flat bar that features small "teeth" along its surface and a handle that is made from wood or plastic. The teeth may only be on one surface or on every facet. When pushed or pulled across the workpiece's surface, the teeth will cut into the surface of the workpiece and lift material away. Files can be found in various shapes and constructed from different materials. They can be used on wood, plastic, and metal. Files are categorized by their shape and the type of teeth they feature. The basic shapes include flat, round, half-round, square, taper, and knife/triangular. The four basic types of teeth are single-cut, double-cut, rasp, and curved-tooth. There are smaller files called needle files that are used to create a smooth surface finish rather than rapid material removal. Diamond files use bonded diamond dust to scratch the workpiece's surface and remove a small amount of material at a time. Diamond files are used on hard surfaces like hardened steel because regular files are too soft.
- **Stones** – Stones are tools used to scratch and polish the surface of the workpiece. Stones are shaped like files without the teeth. They are typically made from aluminum oxide (Arkansas) or ceramic, which means the entire surface of the stone is an abrasive. Stones are used to remove only a minute amount of material to the point of polish. Arkansas stones

Figure 31: Various types of files.

Figure 32: Various types of stones.

tend to be more aggressive because of the aluminum oxide, while ceramic stones are typically used to polish. Stones can be found in a variety of shapes and sizes for various projects.

- **Saw** – A saw is a tool used to cut material with a blade that features many small teeth. There are many different styles of saws for many different purposes, but the basic saw design consists of a handle and a blade. The blade is often quite long (18+ in.), with many small teeth along its bottom edge. There are two basic saw designs that are used in (some) gunsmithing: the crosscut saw and the coping saw. The crosscut saw utilizes a long blade with a handle on one side and is meant mostly for wood. The crosscut saw is so

Figure 33: A crosscut and coping saw.

Figure 34: A variety of chisels.

named because it is used to cut across the grain of the wood rather than with the grain. The coping saw is much smaller and utilizes a U-shaped frame that places tension on a replaceable blade. The coping saw can be equipped to cut wood, plastic, and metal. Both saw types are categorized by the blade's teeth per inch. The teeth per inch and blade material will dictate what type of material can be cut. Lower teeth per inch blades are usually reserved for rough cuts and soft material, while a high teeth per inch is used for hard material and cleaner cuts. Both crosscut and coping saws can be found in various sizes for a variety of materials.

- **Chisel –** A chisel is a hand tool that is primarily used to cut wood. A chisel consists of a handle, shank, and a beveled leading edge. Depending on type, the chisel may be driven by hand or with a hammer or mallet. The cutting edge of the chisel may vary from flat to angled, to pointed, and even to round. Chisels are designed to cut with the grain but can also be used to cut against the grain. Chisels designed to cut deep and remove material rapidly are known as gouges and feature arched leading edges, which dig into the workpiece. Chisels come in a variety of shapes and sizes for different purposes.

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Field Stripping and Reassembly

The term "field strip" refers to a process of firearm disassembly that can easily be accomplished in the field. Field stripping is a partial breakdown of the firearm's major components into more manageable subassemblies. A firearm is typically field stripped so that it can be cleaned and examined.

All manufacturers have a very specific field stripping procedure for any firearm they produce. The field stripping procedure is typically outlined in great detail in the firearm's owner's manual, but may also be found online. While the idea of field stripping a firearm seems fairly standard, specific types and models will have a very specific field stripping procedure.

Because field stripping can be accomplished "in the field," manufacturers make this process quite simple. Typically, there are no tools required to perform the field strip and if there is, often it is only a single punch. In a pinch, the tip of a cartridge, a key, pen, or even a stick can be used to perform the field stripping procedure.

While every firearm model uses a different field stripping procedure, most firearm types (pistols, rifles, and shotguns) can be field stripped in the same basic manner. Regardless of the firearm type, the first step in any field stripping procedure is to make sure it is clear and safe. The basic field stripping procedure for the basic firearm types are:

Pistol – The field stripping procedure will differ between pistols of different types and models. Even similar action types will have a slightly different field stripping procedure. The different pistol types are single-shot, revolver (single- and double-action), and semi-automatic.

The single-shot pistol typically utilizes the break-style action. With most break-action designs, there is a part (either on top or underneath the receiver) called the top lever or takedown

Figure 35: A field stripped firearm.

Figure 36: Tools used to field strip most firearms.

lever/button. The field stripping procedure for break-action pistols (Figure 37) is as follows:

1. Manipulate the top/takedown lever and open the action.
2. You may either be able to roll the barrel forward and detach it from the receiver or you may have to remove the forend first. The forend may be attached with a bolt or spring-loaded release. Remove the forend and then remove the barrel.
3. The action and barrel are now exposed and the field strip is complete.

Figure 37: Field stripping a single-shot pistol.

The single- and double-action revolvers both utilize a revolver-style action. While both actions are fairly similar, the field strip procedure is slightly different. The field stripping procedure for a single-action revolver (Figure 38) is as follows:

1. Set the hammer to the "half-cock" position and open the loading gate.

2. A button under the barrel called the base pin catch is depressed and the base pin is removed, releasing the cylinder.

3. Remove the cylinder from the frame. The action, chambers, and barrel are now exposed and the field strip is complete.

The field stripping procedure for a double-action revolver (Figure 39) is as follows:

1. Depress a button called the cylinder release, found on the left rear of the receiver, and swing the cylinder outward.

2. The action, chambers, and barrel are now exposed and the field strip is complete.

Figure 39: Field stripping a double-action revolver.

Figure 38: Field stripping a single-action revolver.

Semi-automatic pistols use many different actions, from blowback, to recoil-operated and even gas-operated. The field stripping procedure for semi-automatic pistols will vary by make and model but the basic idea is the same: remove the (empty) magazine, remove the slide, remove the barrel (if possible), and remove the action/recoil spring. The procedure will vary with fixed barrel blowback designs and recoil-operated designs.

The field stripping procedure for fixed barrel, semi-automatic pistols is as follows:

1. Remove the magazine.
2. Manipulate the takedown lever/button.
3. Pull the slide to the rear of the pistol and lift upward. There is a cutout in the slide rail that allows the slide to be lifted off the frame.

Figure 40: Field stripping a recoil action, semi-automatic.

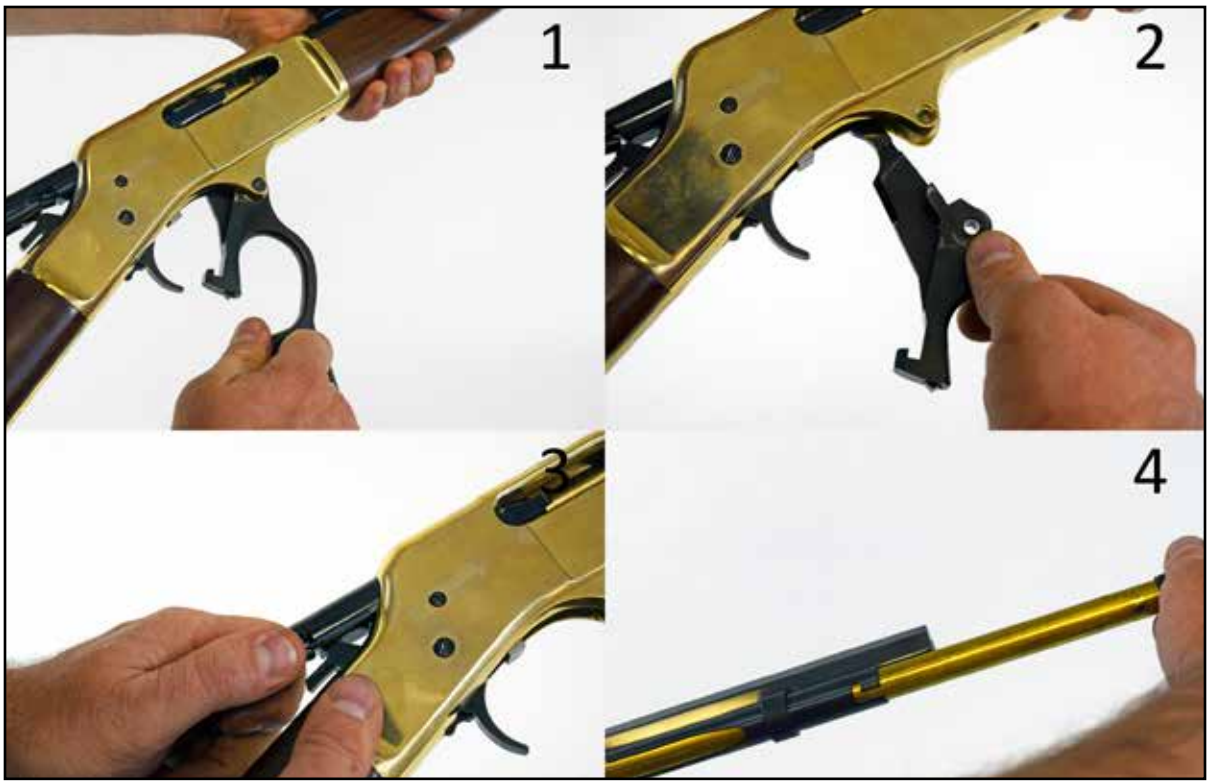

Figure 41: Field stripping a lever-action rifle.

4. Pull the slide forward until it clears the barrel and lift the slide away.
5. Remove the action/recoil spring from the frame.
6. The action, slide, and barrel are now exposed and the field strip is complete.

The field stripping procedure for recoil-operated pistols (Figure 40) is as follows:

1. Remove the magazine.
2. Depending on make and model, the next step may vary slightly. Typically, the slide must be pulled to the rear a short distance. Either the takedown pin is removed or the takedown lever is manipulated.
3. The slide is pulled forward, carrying the barrel and recoil spring with it.
4. The recoil spring is removed from the slide.
5. The barrel is lifted out and removed from the slide.
6. The action, slide, and barrel are now exposed and the field strip is complete.

Rifle – The field stripping procedure will differ between rifles of different types and models. Even similar action types will have a slightly different field stripping procedure. The different rifle types are single-shot, lever-action, bolt-action, and semi-automatic.

The single-shot rifle typically utilizes the break-style action. With most break-action designs,

there is a part (either on top or underneath the receiver) called the top lever or takedown lever/button. The field stripping procedure for break-action rifles is as follows:

1. Manipulate the top/takedown lever and open the action.
2. You may either be able to roll the barrel forward and detach it from the receiver or you may have to remove the forend first. The forend may be attached with a bolt or spring-loaded release. Remove the forend and then remove the barrel.
3. The action and barrel are now exposed and the field strip is complete.

The lever-action rifle utilizes a lever-style action. The lever-style action's field stripping procedure will vary with different makes and models and can be quite complicated with some rifles. The field stripping procedure for some lever-action rifles may require more than just a few standard punches to complete the process. The field stripping procedure for lever-action rifles (Figure 41) is as follows:

1. Manipulate the lever downward to expose the lever pin or screw.
2. Remove the pin or screw and remove the lever.
3. Pull the bolt through the rear of the receiver.
4. If applicable, remove the inner magazine tube/follower from the outer sleeve.
5. The action, bolt, and barrel are now exposed and the field strip is complete.

Bolt-action rifles utilize a bolt-style action. The field stripping procedure for any bolt-action rifle is fairly straightforward and in many cases, requires no tools. The field stripping procedure for bolt-action rifles (Figure 42) is as follows:

1. Manipulate the bolt to unlock the breech and pull the bolt to the rear.
2. Depress a button found on the receiver, called the bolt release, in order to free the bolt from the receiver. Some models may require you to pull the trigger as you remove the bolt.
3. The action, bolt, and barrel are now exposed and the field strip is complete.*

**Please note that not every lever-action firearm is designed to be field stripped so easily. Some rifles require you to completely detail strip in order to access all the parts for cleaning.*

Figure 42: Field stripping a bolt-action rifle.

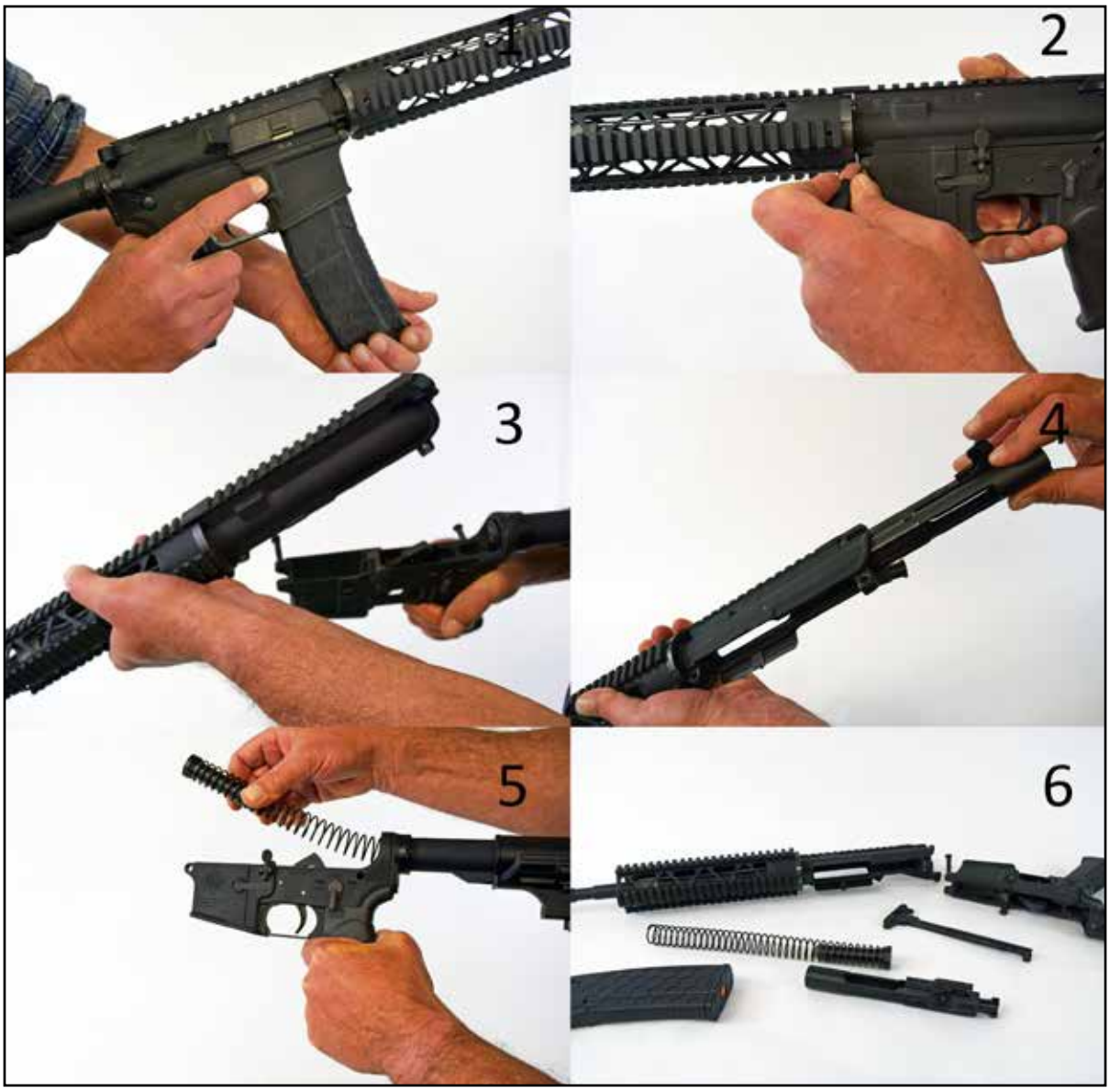

Figure 43: Field stripping a semi-automatic rifle.

Semi-automatic firearms utilize many different action types, from blowback, to recoil-operated and even gas operation. Although there are many different action types and variances, the field stripping procedure for semi-automatic rifles is fairly standardized. The field stripping procedure for semi-automatic rifles (Figure 43) is as follows:

1. Remove the magazine.
2. Depending on make and model, one of two things may need to happen. Either some type of receiver cover is removed or the receiver(s) is separated. Typically, a pin (or pins) holds the two receiver halves together. When the pin(s) is pushed through the receiver, the two halves can be separated.
3. Remove the bolt. Depending on make and model, you may have to remove the charging handle before the bolt can be removed. With some models that utilize a piston, the piston can now be removed.

4. Remove the action/recoil spring.
5. The action, bolt, and barrel are now exposed and the field strip is complete.

Shotgun – The field stripping procedure will differ between shotguns of different types and models. Even similar action types will have a slightly different field stripping procedure. The different shotgun types are side-by-side/over-under, pump-action, and semi-automatic.

Side-by-side and over-under shotguns utilize the break-style action. With most break-action designs, there is a part (either on top or underneath the receiver) called the top lever or takedown lever/button. The field stripping procedure for break-action shotguns (Figure 44) is as follows:

Figure 44: Field stripping a break-action shotgun.

1. Manipulate the top/takedown lever and open the action.
2. You may either be able to roll the barrel forward and detach it from the receiver or you may have to remove the forend first. The forend may be attached with a bolt or spring-loaded release. Remove the forend and then remove the barrel.
3. The action and barrel are now exposed and the field strip is complete.

Pump or slide-action shotguns utilize the pump-style action. The field stripping procedure for pump-action shotguns is fairly standardized, but often requires a few hand tools. The field stripping procedure for pump-action shotguns (Figure 45) is as follows:

1. Pull the slide slightly to the rear to unlock the bolt from the barrel.
2. Remove the magazine/forend cap.
3. Pull the barrel forward until its lower lug clears the magazine tube.
4. Depending on make and model, you may be able to pull the bolt forward out of the front of the receiver or you may have to remove the fire control group and a few other parts. Typically, the fire control group is held in the receiver by a single pin. Remove the pin and pull out the FCG (fire control group).
5. If the bolt has already been removed, you can pull the slide forward off the magazine tube. If the bolt is still in the receiver, you may have to remove the bolt carrier and then pull the slide off. Once the slide is out, you can remove the bolt.
6. The action and barrel are now exposed and the field strip is complete.

Figure 45: Field stripping a pump-action shotgun.

Semi-automatic shotguns utilize a few different action types, including recoil-action, inertia-action, and gas-operated. Although there are several different action types and variances, the field stripping procedure is fairly standardized and similar to the pump-action shotgun. The field stripping procedure for semi-automatic shotguns (Figure 46) is as follows:

1. Remove the magazine/forend cap.
2. Depending on make and model, one of two things must happen. Either the forend is slid forward over the magazine tube and then the barrel is removed, or the barrel is slid forward over the magazine tube and then the forend is removed.
3. Depending on make and model, once the barrel and forend are off you may be able to remove the action/recoil spring.

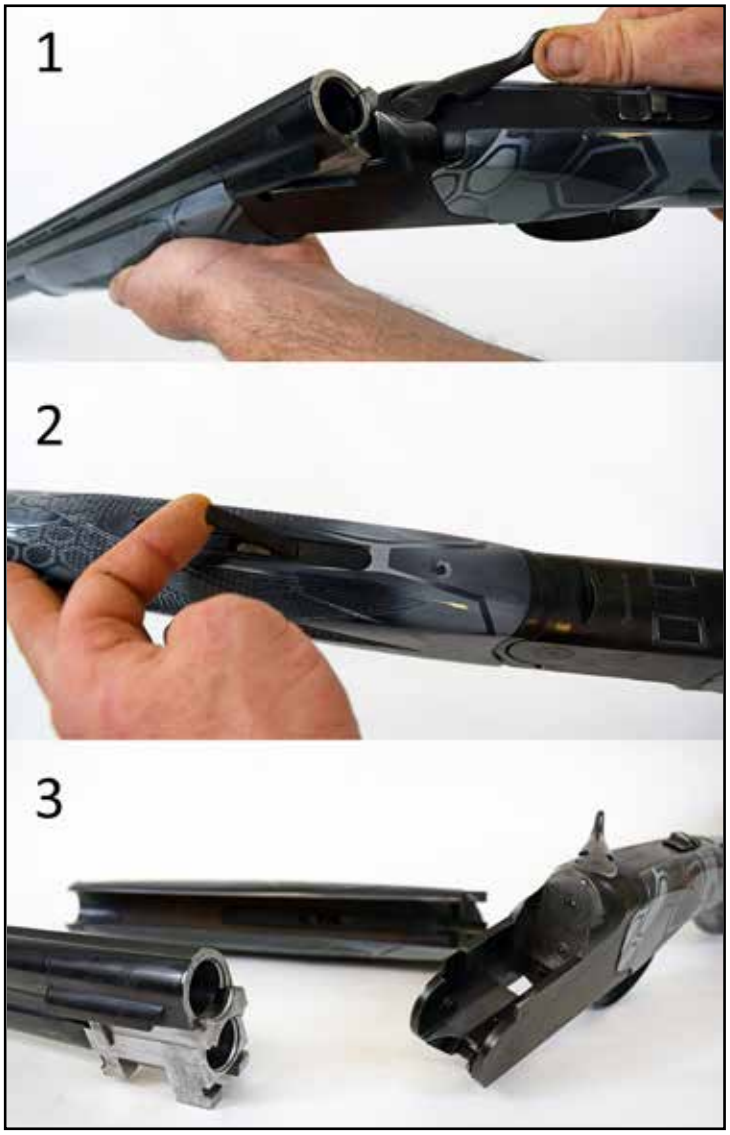

Figure 46: Field stripping a semi-automatic shotgun.

4. Remove the bolt handle by pulling it away from the bolt, out of the ejection port.

5. Depending on make and model, you may either have to remove the bolt or the fire control group. The bolt will slide out of the front of the receiver. Like the pump-action, the fire control group is held in with one or two pins. Remove the pins and remove the FCG. Once the FCG is out, you can remove the bolt.

6. With some models the field stripping procedure is complete; with others you may need to remove the buttstock so that you can access the action/recoil spring.

7. The action and barrel are now fully exposed and the field strip is complete.

Now that the firearm has been broken down into its basic assemblies, you can examine the parts for any wear or damage. You may need to clean the parts before you can do a full examination.

Check the parts for any burrs or gouging and verify that nothing is broken or cracked. You should also check that all springs are in good shape and still have enough force. The most critical areas to be checked are:

- **Barrel** – The barrel should be checked for any cracking or bulging along its exterior. The bore should be examined to make certain the rifling is still crisp and there is no rust or pitting present. If possible, examine the chamber and verify that it is smooth and examine the muzzle for any damage. If applicable, examine any locking surfaces for dings or wear.
- **Action** – The action consists of many parts that make the firearm function, including the receiver, bolt/breechblock/slide, extractor, ejector, and action spring. Check the bolt/breech face for any cracking or damage and examine the firing pin hole to ensure it is not worn or eroded. Examine the locking surfaces on the bolt/breechblock/slide for any damage or excessive wear on the bearing

Figure 47: Areas of the barrel to examine.

Figure 48: Areas of the action to examine.

Figure 49: Areas of the fire control group to examine.

surfaces. Examine the tracks inside of the receiver that the bolt/breechblock move along and check the rails of a pistol slide and frame. Make sure these parts move together freely, without binding or feeling gritty. Examine the extractor for any chips or damage and verify the spring has enough pressure (you can easily move the extractor if the spring is too weak). Examine the ejector for damage and if spring-powered, verify spring pressure.

All action springs should be fairly stiff for proper function.

- **Fire Control Group** – Like the action, the fire control group (FCG) has many parts that control its actions (firing, disconnecting, and resetting). The fire control group consists of the trigger, connector, disconnector, sear, hammer, and firing pin or striker. Examine the engagement surfaces of the sear and hammer/striker for any damage

or excessive wear. Examine the safety/selector and if possible verify function. Manipulate the FCG and verify that the trigger and connector will disconnect and reset. Manipulate the hammer or press against the striker and verify their springs are stiff enough to create ignition. If applicable, cock the hammer and press against the back of it to verify sear engagement (the hammer should not fall). Make certain the FCG parts move freely and do not bind.

- **Furniture** – Make certain that all furniture (stocks, grips, and forends) are properly secured to the firearm. Tighten any screws or bolts or replace any broken pieces. For wood stocks and furniture, check the wood for any cracks or fractures that can lead to part failure.
- **Feeding Device** – Any internal or external feeding device should be checked for spring pressure. Push against the follower to verify magazine spring pressure. Examine the body or housing for any damage, dents, or deformation on the feed lips.

Once the parts have been cleaned and you have verified that everything is in running shape, you can begin the reassembly process. The reassembly process is straightforward, basically following the steps above, but in reverse. Firearms are simple machines and in most cases their parts will only fit together in one way. As long as you pay attention to the steps it took to take it apart, you will be able to reassemble it. All the parts and assemblies will fit together easily; you should not have to force anything. Once the firearm has been reassembled, you can use dummy rounds to perform a function check.

Figure 50: Examine the assemblies for damage and wear.

Power Tools

Power tools rely on an outside power source to drive their motion, unlike hand tools that use physical force. Power tools can be driven by electric motors that are plugged in or run on batteries or pressurized air. These tools make certain tasks much simpler and quicker to accomplish and are an absolute requirement for other tasks.

Power tools are often quite powerful and can be extremely dangerous if proper safety procedures aren't followed. If you are unfamiliar with the safety procedures for a specific machine, take a minute to read the owner's manual or research on the internet. Never operate any power tools unless you completely understand how they work and how to operate them safely.

Anytime you are working with heavy machines and cutting material, you should be wearing safety glasses. In fact, OSHA (Occupational Safety Health Administration) requires employers to provide workers eye protection whenever necessary. While performing machining on various materials, you run the risk of exposure to flying particulate, metal chips, and possibly shrapnel (if a part or tool breaks). You may also need a face shield, hearing protection, dust mask, or respirator (with certain materials like wood or polymer).

Figure 51 : Eye and ear protection.

Your attire may also create a high risk for injury. Loose or baggy-fitting clothing, long sleeves, untucked shirt, gloves, rings, watches, necklaces, and other jewelry may become caught in the machine while it is running, potentially leading to serious injury. Long hair or a beard may also lead to injury if it becomes tangled in the machine. Make certain there is nothing hanging

Figure 52: Various types of hand drills.

from your person that could become trapped in the machine while it is running.

- **Hand Drill** – A hand drill is a tool that is used primarily to cut holes in various types of material. The basic hand drill is shaped like a pistol and is activated by a trigger. Inside the head of the drill is an electric motor that is either powered by a cord or by a battery. A three-jaw chuck attached to the head of the drill secures the tooling being used. The hand drill can accept many types of tooling, from drill bits to grinding wheels and even wire brushes. While the hand drill may be very versatile, it's accuracy and precision are only as good as the operator. Any misalignment or movement of the hand drill is a result of the operator. The modern hand drill is capable of both clockwise and counterclockwise operation and may even feature multiple speed and torque settings. Hand drills come in a variety of sizes with different power levels and features for a variety of tasks.

- **Drill Press** – A drill press is a tool that is used to cut holes in various types of materials, similar to the hand drill but with greater precision. The drill press consists of a base, column, head, and table. The motor and drive assembly are located in the head and are used to spin the three-jaw chuck. The table features holes and provision so the workpiece or various vises can be secured to it. The reason why the drill press is more precise than the hand drill is that it removes the human factor. With a drill press the head is (typically) fixed, the table is fixed, and the workpiece is held securely to the table. This ensures straight, concentric holes because there is no lateral movement. While the drill press is more precise, there is a more extensive setup process than the hand drill, requiring the base and table to be level and plumb to the chuck. Typically, the speed of the drill can be adjusted by simply changing the setting of the pullers or gears in the head. Drill presses can be found in various sizes from tabletop to standalone.

Figure 53: A drill press.

- **Rotary Tool** – A rotary tool is a tool that is extremely versatile, and with the proper tooling is easily adaptable to various tasks. The rotary tool consists of a covered, elongated motor that directly drives a chuck. Typically, rotary tools are powered through a cord, but there are also battery-powered, cordless models.

Figure 54: A rotary tool with various bits.

The rotary tool is so versatile because of the huge array of bits and accessories. There are accessories that can turn the tool into a small drill press, or into a precision pen tool for fine detail work. Bits range from drilling and grinding to cleaning and polishing. There are bits available for virtually any material and almost any purpose. The rotary tool truly is the workhorse of any modern gunsmithing shop.

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Holding/Clamping Tools

Holding and clamping tools are used to secure the workpiece while being worked on. Holding and clamping tools are like having an extra set of hands to hold the workpiece securely while you perform the work. Securing the workpiece while being worked on will ensure the best results because there is little chance of the workpiece moving. The basic holding and clamping tools include:

- **Clamps** – Clamps are tools used to pinch and hold workpieces together or to a workbench. There are various types of clamps for various tasks, but the most common are spring and C-clamps. Spring clamps are similar to pliers, but much wider and spring-loaded. The jaws of the spring clamp are often padded and may even pivot to adjust to the shape of the workpiece. The C-clamp utilizes a C-shaped frame and a long, threaded adjustment screw with a swiveling or rotating jaw to hold the workpiece. There is a fixed jaw on the frame and the screw is manipulated by a handle opposite of the swivel jaw. While the spring clamps provide enough force for most projects, the C-clamps are capable of much higher pressures. Both spring clamps and C-clamps come in a variety of sizes for many different applications.
- **Vise** – A vise is a tool used to hold a workpiece very securely while being worked on. There are various types of vises, but the most common gunsmithing vises are table and machine. Both table and machine vises come in a variety of styles, but the most common types of vises utilize sturdy, heavy bases with one fixed jaw and one adjustable jaw. The other jaw moves along a screw and is adjusted via a handle. The base is typically secured to a sturdy workbench

Figure 55: Various types of clamps.

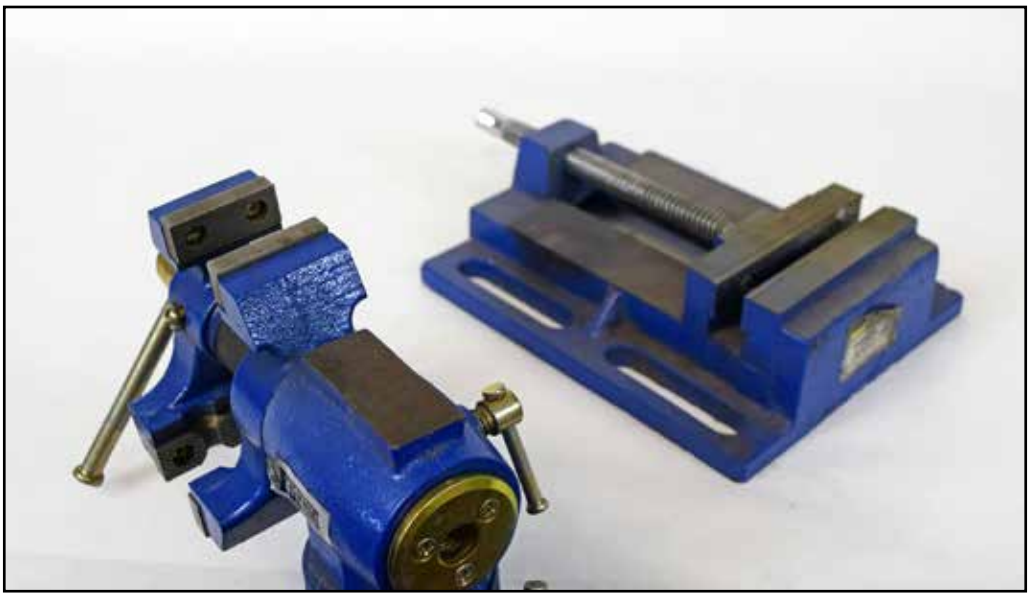

Figure 56: Various types of vises.

or to a machine with bolts. Typically, the jaws of the vise can be removed and replaced with jaws of a different material or shape. Some vises feature multiple points of articulation to allow the workpiece to be held at the correct or most comfortable working angle. Vises are much more sturdy than any clamp and are typically reserved for use with heavy machines or when great force must be applied to the workpiece.

Measuring Tools

Measuring tools are used to verify the size of the workpiece or the dimensions of the work that is to be performed. Measuring tools are often more important to accurate and precise work than any other tool. In fact, measuring tools are often used to measure the accuracy and precision of heavy machinery. The various types of measuring instruments are:

Figure 57: Various rulers and measuring tapes.

- **Ruler/Measuring Tape** – A ruler is a tool that is used to measure distance. The basic ruler features a long, flat body with graduated lines (both standard and metric). The typical ruler is either 12 in. (in 1⁄16 in. increments) or 30 cm long (in 1mm increments) and features a precise straight-edge that can be used for marking. Some rulers feature both inch and centimeter markings and can be found made from wood, plastic, and metal. The measurement standard rulers provide is too course to offer any real precision when fitting small parts, but can be very handy with large parts like stocks and barrels. A measuring tape is like a ruler that is much longer. A measuring tape consists of a long (6+ ft.), thin, metal band that is wound inside a housing. When the band is pulled from the housing, a wound spring will pull it back in. Rulers and measuring tapes can be found in various sizes for a variety of tasks.
- **Calipers** – Calipers are tools used for precision measurement, much finer than any ruler or measuring tape. A caliper consists of a body or main scale, two sets

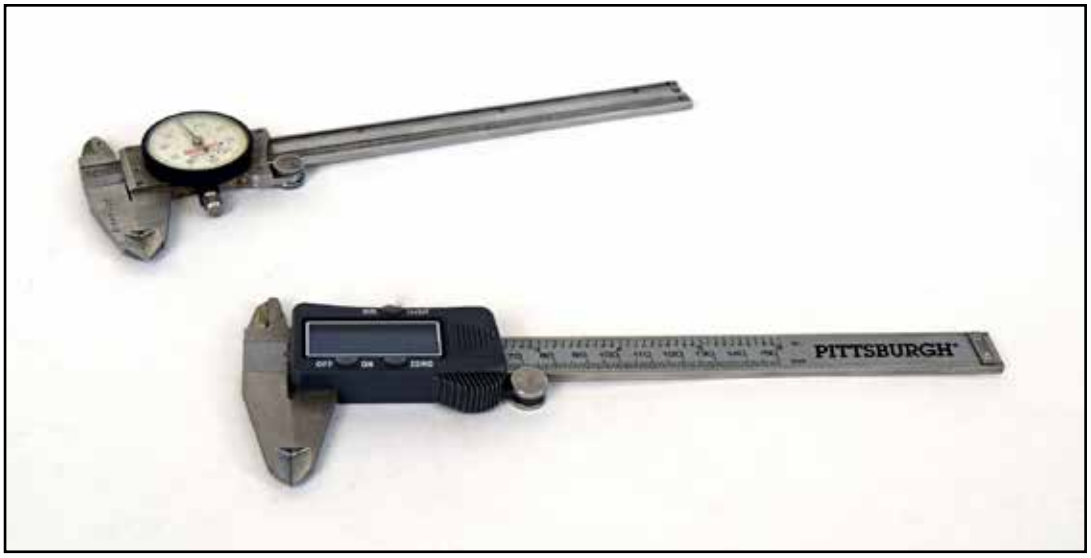

***Figure 58**: Various calipers.*

of jaws, and a depth rod. The typical caliper is capable of measuring in hundredths (.01), thousandths (.001), and ten thousandths (.0001) of an inch or in millimeter decimals. There are various types of calipers that all display the measurements in different ways. The different display types are analog, dial, and digital. The analog or Vernier scale consists of graduated lines in both standard and metric scales. The dial caliper utilizes a dial indicator to display the measurement reading, while a digital caliper relies on an LCD screen. A thumb screw is used to manipulate the jaws and the depth rod. The upper jaws are used to measure the inside of a part's dimensions, while the lower jaws are used to measure the outside of a part's dimensions. The depth rod is used to measure the depth of channels, holes, or voids. There is a variety of different types of calipers for many different purposes.

- **Micrometers** – Micrometers or screw gauges are tools (similar to calipers) that are used for precision measurements. A micrometer consists of a frame, sleeve, thimble, and spindle. One end of the C-shaped frame features an anvil, which the spindle references (zeroes) against. When the thimble is rotated over the sleeve, the spindle will move in and out. Marks on the sleeve and thimble will display the measurement reading. The typical micrometer is capable of measuring in hundredths (.01), thousandths (.001), and ten thousandths (.0001) of an inch or in millimeter decimals. There are individual micrometers that are used to measure inside, outside, and depth, unlike the caliper, which can measure all three with one tool. Micrometers can be found in both analog and digital and are available in a variety of sizes for various tasks.

- **Dial Indicator** – The dial indicator is a gauge that is used to measure "travel" or play in machines like mills and lathes and also in the parts they make. The dial indicator has a movable contact arm. When the arm is moved, the needle rotates on the dial face to show movements in thousandths to ten thousandths of an

Figure 59: A micrometer.

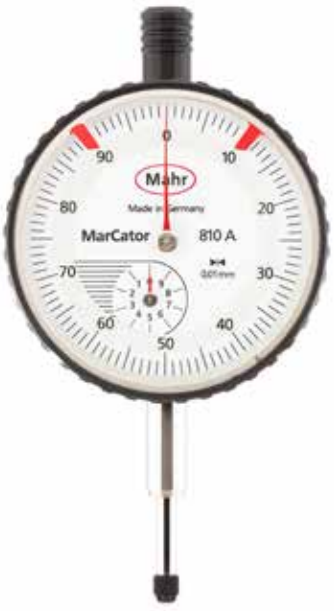

Figure 60: A dial indicator.

inch (.001 – .0001 in.). The bezel around the outside of the dial can be adjusted to set a "zero" or a starting point when the contact arm is preloaded. This will allow you to measure both high and low spots. Typically, the dial indicator must be mounted and secured to give a precise reading. A magnetic base with articulating arms is the most common mount for the indicator. This base provides great versatility. A typical dial indicator and base are shown in Figure 60. Modern indicators replace the dial with an LCD screen and is digital. The main advantage of the digital indicator is that you can instantly switch between inches, fractions of an inch, and metric measurements. Both dial and digital indicators are used frequently in gunsmithing shops. The dial indicator is used for setting up and squaring drill presses, mills, and lathes, squaring and truing the workpiece, and measuring the concentricity of parts on the lathe. Dial indicators can be found in various types for a variety of purposes.

- **Levels** – A level is a tool used to measure the horizontal and vertical angles of a workpiece. The basic bubble or spirit level consists of a sealed, clear glass or plastic tube that is filled (almost full) with alcohol to create a bubble. The tube will feature hash marks to show level. The vial can be used standalone or inside of a housing that will allow it to verify level over a greater area. The level can be found in both analog and digital versions. The advantage of the digital level is its ability to display the degree measurements in increments as small as ⅒°. While a standard bubble level can measure along one plane (X), a bullseye level can measure along two (X and Y). Levels can be found in various sizes for different purposes.

Like with anything in life, high-quality tools will come at a premium. Tools made from superior materials and more precise processes will cost more than tools that are cast from inferior materials. Whenever possible, purchase the highest quality tools you can afford because they will save you more money in the end. Cheap tools will break, and having to purchase them twice will often cost as much as the high-quality alternative. Name brand tools will often come with a no-questions-asked warranty and lifetime replacement.

Figure 61: Various levels.

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Detail Stripping, Review, Reassembly

Earlier you learned how to field strip a firearm and reassemble it. While field stripping is designed to be done in the field and only requires minor tools, detail stripping is the complete opposite. Detailed stripping (for most firearms) should be done in a controlled environment, like a workshop that is well-lit. Detail stripping should never be attempted in the field. There is a great likelihood that you will not have the tools to complete the job or you will lose small parts.

Detail stripping involves breaking a firearm down into its most basic parts. This includes breaking down every subassembly into its individual parts, pins, and springs. Detail stripping is performed for many reasons, including thorough cleaning, repair, customization, and refinishing.

Although there are many different firearm types, makes, and models, the detail stripping process always begins at the same place: the field strip. The field stripping procedure for most firearms has been outlined earlier and can typically be found online, either in an article or in a video. The most important thing to consider when working with firearms is safety. Before beginning, make certain the firearm is clear and there is no ammunition present in the workplace.

Before beginning, make certain you have everything that you need to successfully complete the detail strip. Research, planning, and preparation have all been outlined earlier and should have prepared you for this moment. You may also need a few items that were not outlined earlier. These items include:

- **Magnetic Parts Tray** – A magnetic parts tray is used to hold small parts that are magnetic. The tray features a powerful magnet on its base that is meant to secure small parts to prevent loss.

Figure 62: A firearm that has been completely detail-stripped in preparation for cleaning.

Figure 63: Various other items needed to detail strip any firearm.

- **Sandwich Bags** – Small, sealable sandwich bags are used to hold small parts that may not be magnetic. Sandwich bags can also be used to separate the small parts of different assemblies to prevent accidentally mixing parts. Bags can easily be marked with a permanent marker.
- **Shop Rags** – Rags are used to wipe or clean parts so they can be examined. Shop rags can also be used to protect the finish on parts that are held in a vise or by clamps.
- **Various Brushes** – Brushes are used to clean tough or caked-on debris that rags could not. Brushes can be found with many different bristle types, including nylon, brass, and stainless steel. The various bristle materials will allow you to clean various surfaces without damaging the finish of the part.
- **Small Light** – A small flashlight is used to see in hard-to-reach areas. A small light will allow you to see inside of areas where shop lights do not reach, like the bore and chamber.
- **Camera or Camera Phone** – A camera or camera phone will allow you to take pictures of assemblies and how the individual parts are arranged. Taking pictures of unfamiliar assemblies will guarantee proper reassembly. Pictures can also be used to show a customer any concerning areas or damage that you may find. Pictures may also provide a bit of insurance for yourself if there are scratches on the finish and the owner tries to blame you.
- **Notepad** – A notepad can be handy for any notes you may need to take to help you with the reassembly process. You can use the notepad to keep track of steps or to work out calculations when fitting parts.
- **Specialty Tools** – Some firearms may require specialty tools that are proprietary to each specific firearm. As we discuss

Figure 64: Preparing to detail strip a firearm.

the nuances of each firearm type, we will discuss the need for specialty tools.

At this point you should have everything you need to completely detail strip any firearm. You should be mentally prepared, have a plan, and your tools and workspace should be organized. Begin by field stripping the firearm. Organize all of the parts and subassemblies in preparation for detail stripping.

Now that you have broken the firearm down into subassemblies, you can begin to break down each assembly into its individual parts. This is where things get a bit harder. While field stripping is fairly easy and straightforward, detail stripping requires a lot more critical thinking. You can start punching out pins and removing screws, nuts, and bolts until everything falls into a pile of parts on your workbench, but you will never gain an understanding of the parts and how their relationship with each other affects function.

When disassembling subassemblies, there are certain orders of operation and assembly techniques to keep in mind. Pins, nuts, bolts, and springs can all introduce a certain level of difficulty to any disassembly/assembly process. Pins are generally removed from left to right and installed from right to left. This includes solid, roll, and taper pins. If you find a pin is giving you trouble, do not continue to pound on it; you may simply need to change direction. The same applies to nuts and bolts. Most nuts and bolts feature a right-hand thread, meaning they will thread onto/into the workpiece clockwise and off counterclockwise. There are some European or Asian models of firearms that utilize left-hand threads, meaning they will thread onto/into the workpiece counterclockwise and off clockwise. Also, pay close attention to any springs that you remove from the assemblies. They may be directional and only work properly one way.

Figure 65: Pushing pins from left to right.

Specific firearm types will have certain nuances that make the disassembly and reassembly process a bit more challenging. A general overview of the differences is covered in the following sections. You may need to do further research and planning for variations of specific models. Please note that the following is not a step-by-step guide; it is a reference for the most difficult aspects of each firearm type. You will need to figure out the correct sequence of steps to properly disassemble the firearm.

BREAK-ACTION FIREARMS

Although the break-action design is fairly simple, much of the difficulty when disassembling break-action firearms comes from the FCG. The reason for this is because much of the FCG is housed in such a compact receiver. This means that the parts inside of the receiver are often very compact and packed in very tightly, especially with side-by-side and over-under shotguns.

Typically, the toughest parts to disassemble and assemble are the hammer, strut/plunger, and hammer/mainspring. The hammers are under substantial spring force and are sometimes very difficult to install. To access the FCG you may need to remove the buttstock or you may have to remove the sideplate. Both are typically secured with machine screws.

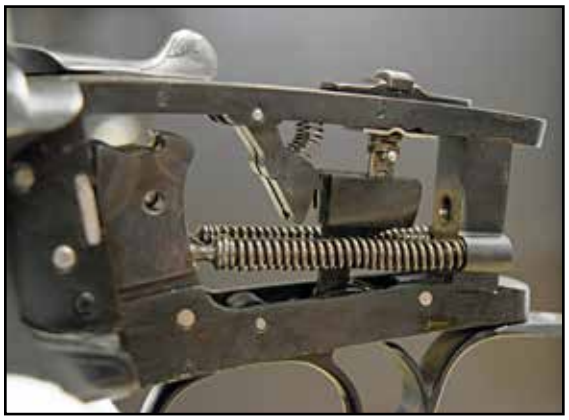

Figure 66: Over-under fire control group.

Figure 67: Removing the hammer spring.

Sometimes, manufacturers will machine a small hole near the back of the hammer strut/plunger. When the hammers are in the cocked position, the springs are fully compressed and the hole in the strut/plunger are exposed. Placing a small pin or paper clip in the hole and slowly releasing the hammer will trap the spring and relieve the force on the hammer. Now the hammer pin or screw can be removed and the hammer(s) can easily be removed. If the hammer strut/plunger does not feature this takedown hole, you will need a specialty U-notched screwdriver to compress and remove the hammer spring.

Once the hammers have been removed, much of the rest of the FCG can be removed with little fuss. Other parts that can be difficult to remove include the top lever, hammer cocking cam/lever, and extractor/ejector. All of these parts are under heavy spring pressure as well, making removal and installation slightly difficult. To make things easier, the receiver should be securely held in the vise. Be careful not to tighten the vise too much because you may crush the receiver.

The rest of the subassemblies are straightforward. The remainder of the FCG, action, and furniture can all be disassembled with ease. Many of the parts are all held together with machine screws and solid pins. Typically, even the sights are threaded and can be removed with little effort.

ROLLING BLOCK, FALLING BLOCK, AND LEVER-ACTION FIREARMS

The rolling block, falling block, and lever-actions all function in a similar matter, which makes disassembly and assembly similar. The biggest difference between the three is that the lever-action utilizes a feeding device. The most difficult disassembly procedure for any of these actions is the removal of the barrel. In most cases, removal of the barrel is not absolutely necessary; but if it must be removed, it can be quite difficult without the proper specialty tools.

Typically, barrels are attached to the receiver by a threaded tenon. The barrel is torqued anywhere between 80 ft-lb. and 120 ft-lb. The barrel may also be pinned to prevent it from rotating lose. If the barrel is threaded, you will need a specialty wrench and vise jaws. A universal action wrench (Figure 68) can be found at Brownells, along with model-specific wrenches and barrel vises.

Figure 68: A universal action wrench available from Brownells.

To remove a threaded barrel from a falling block/rolling block/lever-action rifle, the rifle must be fully stripped. If the barrel is pinned, remove the pin. If the barrel and receiver do not feature index marks, use a paint marker or sharpie to mark the position of the barrel. You can also make a small mark with a scribe if the finish is not a concern. Secure the barrel in a barrel vise or vise jaws. Attach the action wrench to the receiver and make sure it is secure. Apply force to the action wrench until the receiver begins to turn. Typically, the barrel features right-hand threads, which means the

Figure 69: A 20-ton shop press.

Figure 70: Remove the magazine tube.

receiver must turn counterclockwise (from behind the receiver) to be removed. Once the barrel breaks free, remove the wrench and unscrew the receiver by hand.

If the barrel is pressed, you may want to leave it as is. Removing pressed barrels requires a heavy duty (20-ton) press, a drift bar, and a little ingenuity. You will need to secure the receiver while the drift pushes the barrel out of the receiver from the breech end. Without the proper tools and setup, you run the risk of damaging the barrel and receiver and still may not even be able to remove the barrel. Do not remove pressed barrels if not absolutely necessary.

The magazine tube of the lever-action is the next challenging assembly. The magazine tube may be secured in several ways. The tube may be screwed to the receiver or held in place by a dovetail lug or a barrel band. The receiver should be secured in a vise before the magazine tube is removed. If the magazine tube is screwed, you will need to unscrew it, being careful not to crush the tube. If the tube is held by a lug, drift the dovetail of the tube to the right until it is free. If the tube is held by a barrel band, loosen the band and slide it off the barrel and remove the tube.

After the barrel and magazine tube, the hammer assembly is the next challenging assembly. Like the break-action hammer assembly, the lever-action hammer strut may feature a takedown hole. If the hole is present, insert a pin or paper clip into it and relieve the spring pressure on the hammer. If the hole is not present, you will need to use a U-notch screwdriver to compress the spring and remove it.

The rest of the subassemblies are straightforward. The remainder of the FCG, action, and furniture can all be disassembled with ease. Many of the parts are all held together with machine screws and solid pins. Typically, the sights are pressed in dovetails and can be removed with little effort.

BOLT-ACTION FIREARMS

The bolt-action is also a fairly simple design, but it can have its own difficulties. Like the lever-action, the most difficult aspect of the disassembly process is the barrel. Although the

barrel removal is not an absolute necessity, at some point you may have to remove a barrel for replacement. Typically, most bolt-action rifle barrels are attached to the receiver by a threaded tenon and torqued somewhere between 80 ft-lb. and 120 ft-lb.

To remove a bolt-action rifle barrel, the process is the same as the lever-action. Mark the position of the barrel and place the barrel in a barrel vise. Attach the action wrench to the receiver and make sure it is secure. Apply force to the action wrench until the receiver begins to turn. Typically, the barrel features right-hand threads, which means the receiver must turn counter-clockwise (from behind the receiver) to be removed. Once the barrel breaks free, remove the wrench and unscrew the receiver by hand.

After the barrel, the next challenging assembly is the firing pin/striker. The firing pin/striker is under significant spring pressure and can lead to injury if not removed correctly. Brownells sells a bolt-action firing pin removal that can ease the disassembly procedure. The tool helps

Figure 71: Firing pin removal tool.

to compress the firing pin/striker spring so that it can be removed from the bolt. Once the spring has been compressed, the retaining cap/pin can be removed and the spring can slowly be released.

The rest of the subassemblies are straightforward. The remainder of the FCG, action, and furniture can all be disassembled with ease. Many of the parts are all held together with machine screws, roll pins, and solid pins. Typically, the sights are pressed in dovetails and can be removed with little effort.

Figure 72: A Remington 870 fire control group.

PUMP-ACTION FIREARMS

With pump-action firearms, much of the detail strip has been completed with the field stripping procedure. The disassembly of most pump-action shotguns is fairly straightforward, with the hardest assembly typically being the FCG. The Mossberg 500® is notorious for the difficulty in assembling the FCG; in fact, the manufacturer does not recommend taking it apart.

If you need to take apart the FCG on a pump-action shotgun, pay close attention to the arrangement of the parts and their springs. While the process does not require any specialized tools, it does require some care. Some of the springs in the FCG are meant to power more than one part and tend to feature many bends and turns and weave between various parts. Take pictures or notes of how the springs are arranged and how they interact with the FCG. You may need to place the housing inside a vise so that you have both hands to manipulate the parts, pins, and springs.

Another part that you may have some trouble with is the forend and slide tube. Typically, the forend surrounds the slide tube and is held in place by a castle nut. A specialty tool is required to remove the forend. The tool can be found through Brownells. If you already own the tool, the procedure is straightforward. Remove the castle nut and remove the forend.

The rest of the subassemblies are straightforward. The remainder of the FCG, action, and furniture can all be disassembled with ease. Many of the parts are all held together with machine screws, roll pins, and solid pins. Typically, the sights are pressed in dovetails and can be removed with little effort.

REVOLVERS

Several of the revolvers' assemblies can be challenging, both from the process and the tools required. Typically, the most difficult assembly to remove is the barrel. Like rifles, revolvers utilize barrels that are either screwed on or pressed in. Where screwed or pressed, both are typically pinned as well.

Like rifles, revolvers also require a specialized frame and barrel wrench to remove the barrel from the receiver. The proper tools can be found at Brownells. Before removing the barrel, the barrel pin must be removed and the barrel and receiver must be marked. To remove the barrel, it must be secured in the barrel vise and the action wrench must be attached to the frame. Apply force to the action wrench until the frame begins to turn. Typically, the barrel features right-hand threads, which means the receiver must turn counterclockwise (from behind the frame) to be removed. Once the barrel breaks free, remove the wrench and unscrew the frame by hand.

Figure 73: A Brownells forend wrench.

Figure 74: A Brownells revolver frame and barrel wrench.

Figure 75: Removing the ejector rod from the cylinder.

Removing the ejector rod from the cylinder of a double-action revolver can be a bit tricky. First, the end of the rod is knurled and can easily be damaged. Second, the rod utilizes left-hand threads and must be removed clockwise (from behind the rod). You will need pliers and masking tape or a small strip of leather. Tape the knurled portion of the rod or wrap the piece of leather around it. Grasp the end of the (covered) rod with the pliers and turn it until it is free. Once the rod is free, finish turning it by hand.

The sideplate of the double-action revolver is precision-machined to provide a gap-free fit inside the frame. Often, the fit is so tight the parts appear to be seamless. Once the sideplate screws have been removed, the sideplate will often have to be pried up. The inside edge of the sideplate may be sharp or burred, which can cut you if you try to pry it with your finger. Use a nylon punch under the rear edge of the plate and slowly pry the plate upward to the front of the pistol. There is typically a tab on the front edge of the plate that fits into a slot in the frame. Pull the plate up and outward until the tab clears the frame, and then remove the plate. When installing the plate, you may need to set it by tapping it with a rubber hammer until it sits flush.

The rest of the assemblies are straightforward. The remainder of the FCG, action, and grips can all be disassembled with ease. Many of the parts are all held together with machine screws, roll pins, and solid pins. Typically, the sights are pressed in dovetails and can be removed with little effort.

Figure 76: Removing the sideplate.

Figure 77: Removing the hammer/sear/trigger housing.

SEMI-AUTOMATIC PISTOLS

Most semi-automatic pistols are fairly straightforward and only require a handful of hand tools to completely disassembly. Often, the most difficult disassembly processes are with the FCG, specifically the hammer/sear/trigger housings in the rear of the frame. These assemblies tend to be tightly packed with many small parts and springs. These assemblies often control many aspects of the pistol's function, in a package smaller than a square inch.

Be careful when removing these assemblies because there is a chance that they will fall apart once you lift them from the frame. If you have not taken a picture or taken notes, you may find yourself at a loss of how these parts were arranged. You also run the risk of losing small parts or having a spring fly away.

Reassembly may require a tool known as a "slave pin" to aid in the process. A slave pin is like a short version of the standard pin required. The slave pin will hold the smaller assemblies together while being inserted into the frame. Once the parts are set, the real pin is driven into the frame and the slave pin is pushed out. Slave pins can be made from old used pins by cutting the length.

Many of the other assemblies face this same dilemma because many of the parts of a pistol are so small. In fact, as the size of the pistol decreases (full-size, compact, sub-compact, micro), so do the parts. Needle-nose pliers, tweezers, and

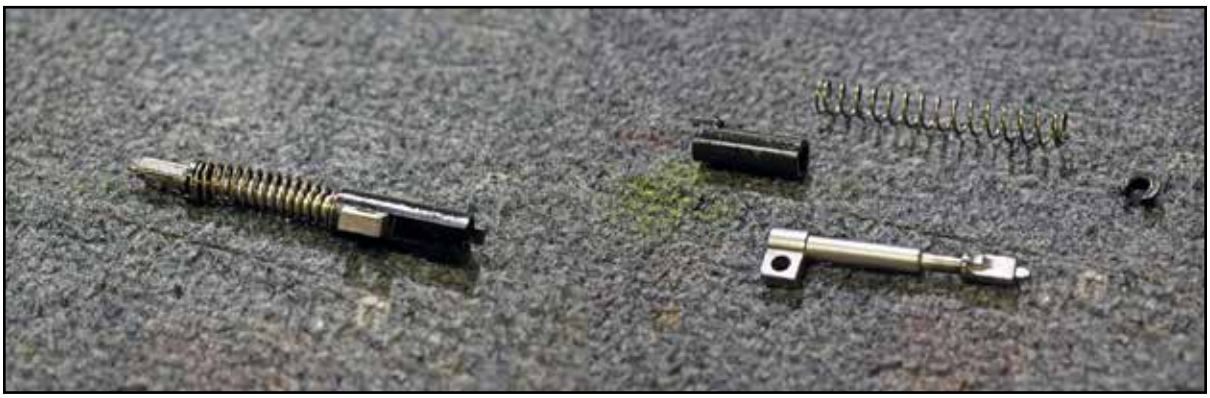

Figure 78: Removing the striker spring cups.

hemostats can all be lifesavers when working with small pistols and small parts.

Striker-fired pistols utilize a spring-loaded striker that is typically held together with tiny spring cups. The striker spring must be compressed far enough for the cups to clear the shoulder of the striker. The cups are very small and easily lost. When installing, both spring cups must be set at the same time before relieving pressure on the striker spring.

The rest of the assemblies are straightforward. The remainder of the FCG, action, and grips can all be disassembled with ease. Many of the parts are all held together with roll pins and solid pins. Typically, the sights are pressed into dovetails and can be removed with little effort.

SEMI-AUTOMATIC RIFLES

Semi-automatic rifles present their own unique difficulties when disassembling, but one challenge they all share is their sheer number of parts, both large and small. Outside of the volume of parts, the most difficult assemblies to remove are always the barrels. Semi-automatic rifle barrels are secured in several ways, including with a threaded tenon, being pressed and pinned, and with a barrel nut.

Typically, semi-automatic rifles manufactured before the late 1950s will utilize barrels that are screwed or pressed. Disassembly procedures for screwed and pressed barrels mirror the manual action rifle procedures. Screwed barrels require a barrel vise and a specialized action wrench, and pressed barrels require a 20-ton press and a drift tool.

Modern semi-automatic rifles typically all use some type of barrel nut or multiple bolts. Instead of the barrel being threaded and screwed into the receiver, or being pressed in, rifles that utilize barrel nuts feature barrels that simply slip into the receiver. The barrel features a shoulder that will bottom out against a shoulder on the receiver. The barrel nut slides over the barrel and is torqued to the receiver. To remove a barrel nut, you will need a specialized tool called a barrel nut wrench. Because there are a variety of different types of semi-automatic rifles, there are various types of barrel nut wrenches. Each model will typically have its own proprietary wrench. Almost all barrel nuts are right-hand threaded, which means you must turn them counterclockwise (looking from the muzzle) to remove them. To remove a barrel nut, first you must secure the receiver in a vise. Place the barrel nut wrench on

Figure 79: Various barrel nut wrenches.

Figure 80: Removing a gas block.

the barrel nut and make sure it is properly aligned and secure. Apply force to the wrench until the nut begins to turn. Once the nut breaks free, remove the wrench and unscrew the nut by hand.

If the barrel is secured with multiple bolts (like the FN USA SCAR), removal is much simpler. Often, all that is required is a set of Allen wrenches. Simply remove all the bolts holding the barrel to the receiver and remove the barrel.

Gas-operated, semi-automatic firearms present unique challenges. Both gas impingement and piston-operated actions utilize gas blocks that are typically pressed or pinned and require precise alignment. Pressed gas blocks require a press for removal and can be very challenging. Typically, the gas block must be secured while the barrel is pushed through it. Gas blocks that are pinned utilize taper pins that are often pressed in place. They will either have to be pressed out or driven out with a large hammer and punch.

The rest of the assemblies are straightforward. The remainder of the FCG, action, and furniture can all be disassembled with ease. Many of the parts are all held together with roll pins and solid pins. Even the sights are typically bolted on and are very simple to remove.

SEMI-AUTOMATIC SHOTGUNS

Semi-automatic shotgun detail disassembly is fairly straightforward, with the exception of the FCG. Like the pump-action shotgun, the semi-automatic shotgun's FCG is fairly complicated. The FCG often contains many small parts and springs.

If you need to take the FCG on a semi-automatic shotgun apart, pay close attention to the arrangement of the parts and their springs. While the process does not require any specialized tools, it does require some care. Some of the springs in the FCG are meant to power more

Figure 81: Disassembling a semi-automatic shotgun fire control group.

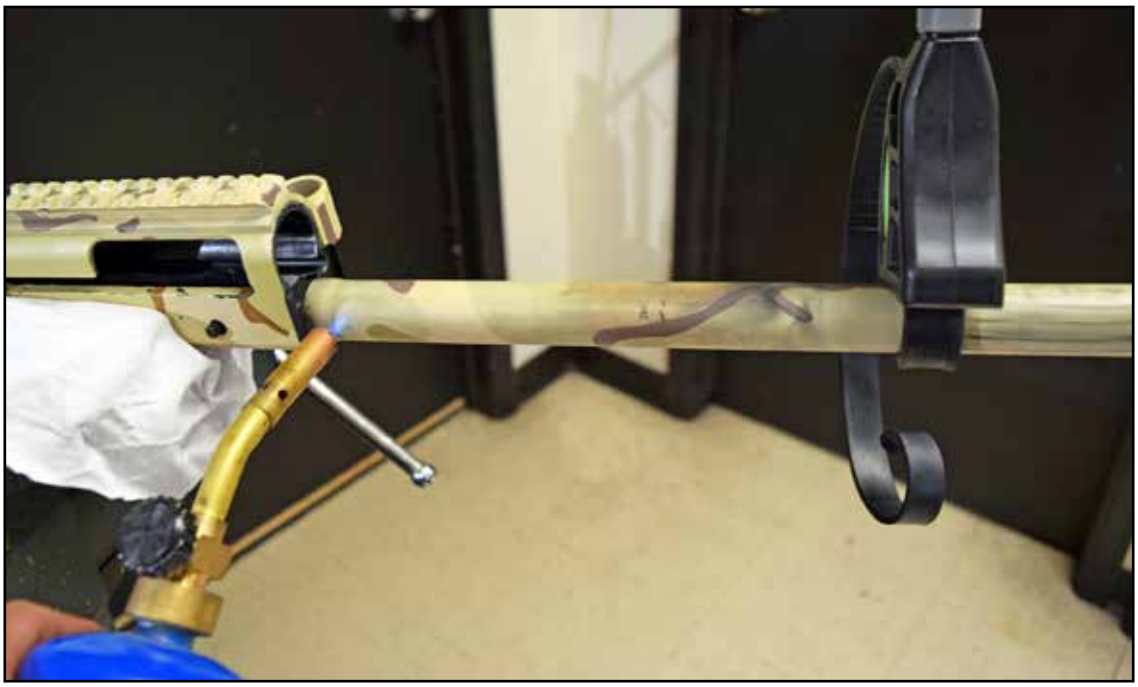

Figure 82: Removing the magazine tube.

than one part and tend to feature many bends and turns and weave between various parts. Take pictures or notes of how the springs are arranged and how they interact with the FCG. You may need to place the housing inside a vise so that you have both hands to manipulate the parts, pins, and springs.

Removing the magazine tube can also be a fairly challenging task. While other parts that are threaded on are just torqued or pinned in place, magazine tubes are typically "glued." Manufacturers often use threadlocking compound when installing the magazine tube. To remove the magazine tube, you will have to heat the tube and the receiver until it breaks the thread lock's hold. This typically occurs around 200˚ – 400˚ Fahrenheit. You will need to turn the tube while it is hot, so you must wear gloves or cover the tube. It may be easier to secure a strap wrench to the tube before heating and using the wrench to remove the tube. Be careful not to crush the tube when using tools to remove it. The tube is typically right-hand threaded, which means you will need to turn the tube counterclockwise (from the muzzle end). You will have to remove the tube while it is still warm; if you allow it to cool, the threadlock compound will set and seize the tube.

The rest of the assemblies are straightforward. The remainder of the FCG, action, and grips can all be disassembled with ease. Many of the parts are all held together with roll pins and solid pins. Typically, the sights are threaded and can be removed with little effort.

REVIEW AND REASSEMBLY

Now that the firearm has been broken down completely, you can examine the parts for any wear or damage. You may need to clean the parts before you can do a full examination. Check the parts for any burrs or gouging and verify that nothing is broken or cracked. You should also check that all springs are in good shape and still have enough force.

Figure 83: Tightening a barrel nut.

Once the parts have been cleaned and you have verified that everything is in running shape, you can begin the reassembly process. The reassembly process is straightforward, basically following the steps required to detail strip the firearm, but in reverse. Firearms are simple machines and in most cases, their parts will only fit together in one way. As long as you pay attention to the steps it took to take it apart, you will be able to reassemble it. All the parts and assemblies will fit together easily; you should not have to force anything. Once the firearm has been reassembled, you can use dummy rounds to perform a function check.

One very important aspect of the reassembly process to consider is the torque value of barrels, barrel nuts, and other parts that are bolted together. These parts are designed to hold at a specific torque: too little and they may rotate loose; too much and you run the risk of breaking parts. The barrel nut may also have to be indexed so that it will clear gas tubes or pistons. Make sure you know the specific torque value of a part before disassembling or assembling. Anytime a threaded or pressed barrel has been removed and reinstalled, the rifle's headspace should be checked.

The alignment of the gas block is critical to the function of gas-operated semi-automatic rifles. Pressed gas blocks tend to be the most difficult to install and may require you to remove and reinstall several times before the alignment is correct. Gas blocks that are bolted in place may also require minor adjustments before their alignment is correct. Lightly tightening the block's bolts until the block is snug will allow

Figure 84: Aligning a gas block.

Figure 85: Using a drift pin to hold an assembly together.

you to make slight adjustments until it is correct. Once the alignment is set, tighten the bolts completely. Pinned gas blocks are typically the easiest to align. The pinned blocks typically use taper pins, which force the block into place as they are driven into place.

Be cautious with stiff springs, especially heavy hammer and action springs. Always wear eye protection because there is always the risk of springs flying at a high rate of speed. Whenever possible, cover the spring or assembly to minimize loss. Utilize slave pins and drift punches to help hold spring-loaded assemblies together while assembling.

To minimize the risk of damaging the firearm's finish during assembly, use masking tape to protect areas that may get scratched or dinged. Cover your workspace with a soft blanket or towel and keep unused tools away from the parts. Whenever possible, use nylon or plastic tools to assemble the parts to avoid accidentally striking them with metal tools.

NOTES


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